5. APPLICATION NOTES

5.1 Ringer Equivalence Number (REN) Considerations

Several requirements related to the on-hook impedance of direct connected TDDs are dependent upon the Ringer Equivalence Number (REN). While the REN is derived from the ringer equivalence, it is actually a means of allocating the acceptable loading with respect to several parameters of all entities at the network interface.

REN can be any value from 0.0 to 5.0 in increments of 0.1. In addition, the sum of the REN's for all equipment entities which bridge a telephone line may not exceed 5.0 and therefore, if an equipment entity (e.g, a TDD, telephone, data set, etc.) has a REN of 5.0, it can be connected to the line only if there are no other entities (except those having a REN of 0.0) connected to that line. Entities having a REN of 4.0 or less can generally be connected to a line which has one telephone (telephones usually have a REN of 1.0) connected.

The limit of a particular impedance for a given REN is determined by dividing the nominal value of that impedance for a REN of 1.0 by the given REN. The limit of a particular current for a given REN is determined by multiplying the nominal value of that current for a REN of 1.0 by the given REN. Since rounding of the REN to the nearest 0.1 is required, the limiting value for a particular impedance or current for a given REN is actually determined by adding 0.05 to the given REN, then dividing or multiplying as required and rounding appropriately.

The REN of a TDD can be found by dividing the impedances and currents specified in this standard that are a function of the REN value by the actual impedances and currents of the TDD and taking the largest value. The use of impedances and currents that meet the requirements for all ringing types in this standard may result in larger REN values than required for compliance with the FCC Rules and Regulations in some cases.

5.2 Mark Hold Time

5.2.1 Function

The mark hold time provides a period of mark signal following the stop bits in Baudot operation when another character is not to be sent immediately. The purpose of this tone is to provide a means of echo suppression to prevent the transmitted signal from echoing back to the receiver of either of the two TDDs communicating with each other. If this echo suppression tone were not present, the receivers

of TDDs could recognize the echos as valid data and garbled characters might result.

5.2.2 Receiver Modem Design

There are two different receiver modem design approaches in the TDD network for the Baudot code. The first, referred to as a single channel design, detects only the space signal. This design assumes that a mark signal is preesent at any time during the character interval following the receipt of a start bit when the space signal is absent and that no signal is present in the absence of a space signal at other times. The second design approach, referred to as a dual channel design, detects both the mark and space tones.

APPENDIX A BIBLIOGRAPHY

(A1) EIA Standard RS-470, Telephone Instruments with Loop Signaling for Voiceband Applications.

(A2) Federal Communications Commission Rules and Regulations, Part 68, Connection of Terminal Equipment to the Telephone Network.

(A3) ANSI X3.4-1977, American National Standard Code for Information Interchange.

(A4) ANSI/EIA 496-1984, Interface between Data Circuit-Terminating Equipment (DCE) and the Public Switched Telephone Network (PSTN).

(A5) IEEE Standard 269-1983, Method for Measuring Transmission Performance of Telephone Sets.

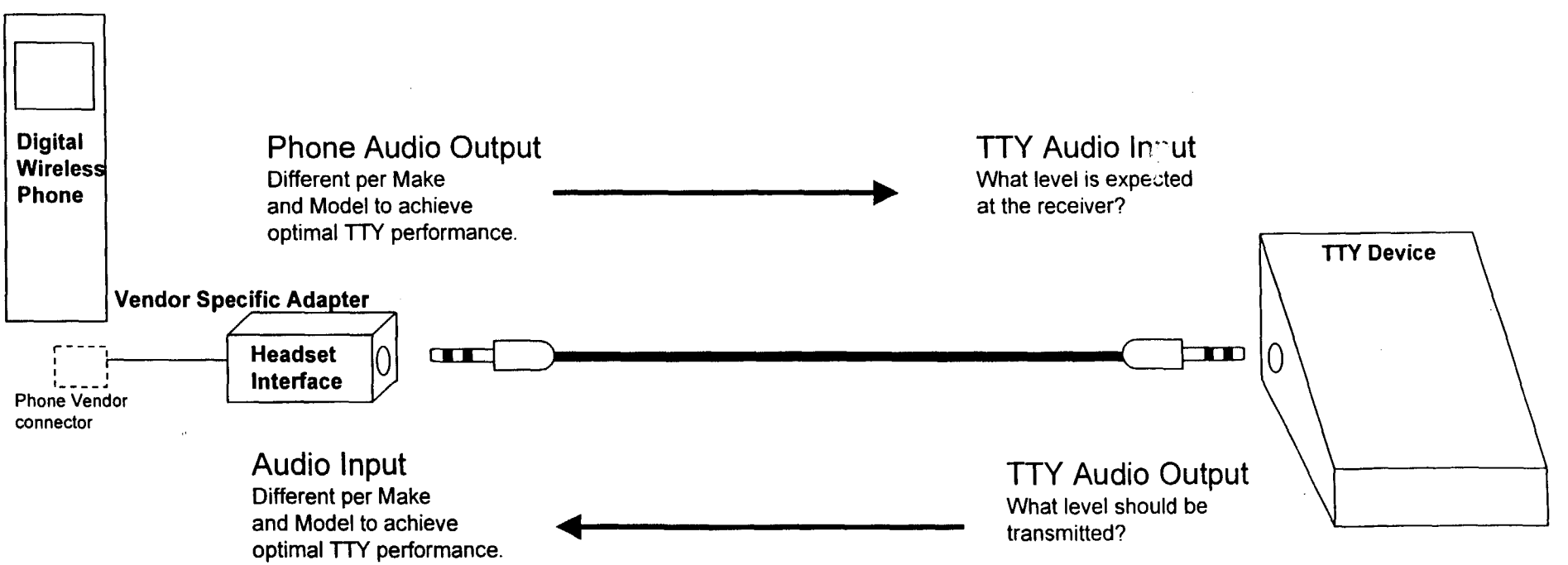
(A6) IEEE Standard 455-1976, Measuring Longitudinal Balance of Telephone Equipment Operating in the Voiceband.

APPENDIX K

Proposed - Wireless Phone 2.5mm Audio Interface to TTY/TDD

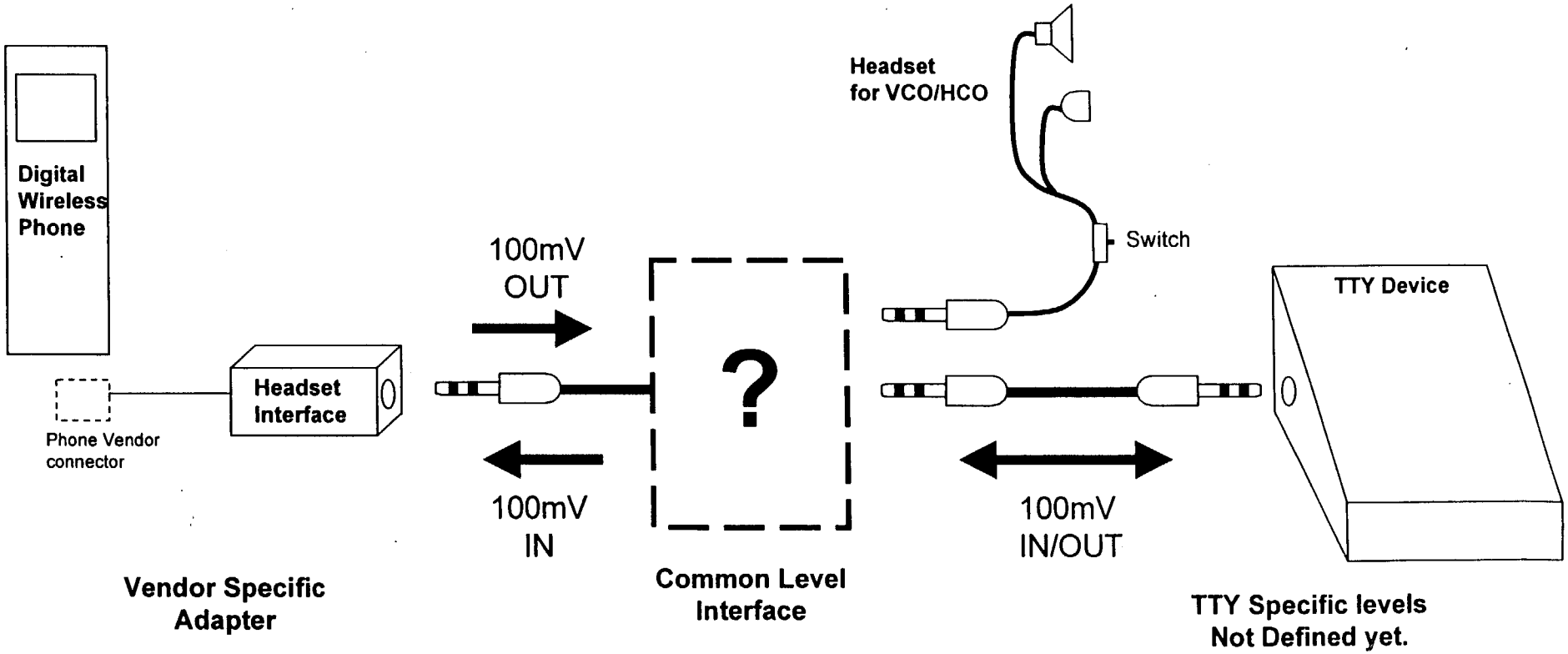
Standardized Levels???

- Output and Input levels are different for each make and model phone.
- Phone Manufacturer's would need to provide a special adapter with standard levels. This would be a different product than what is available today for their products.
- TTY Output and Input levels for a connection to a Digital Wireless Phone are not established yet.
- How is VCO (Voice Carry Over) and HCO (Hearing Carry Over) made accessible?



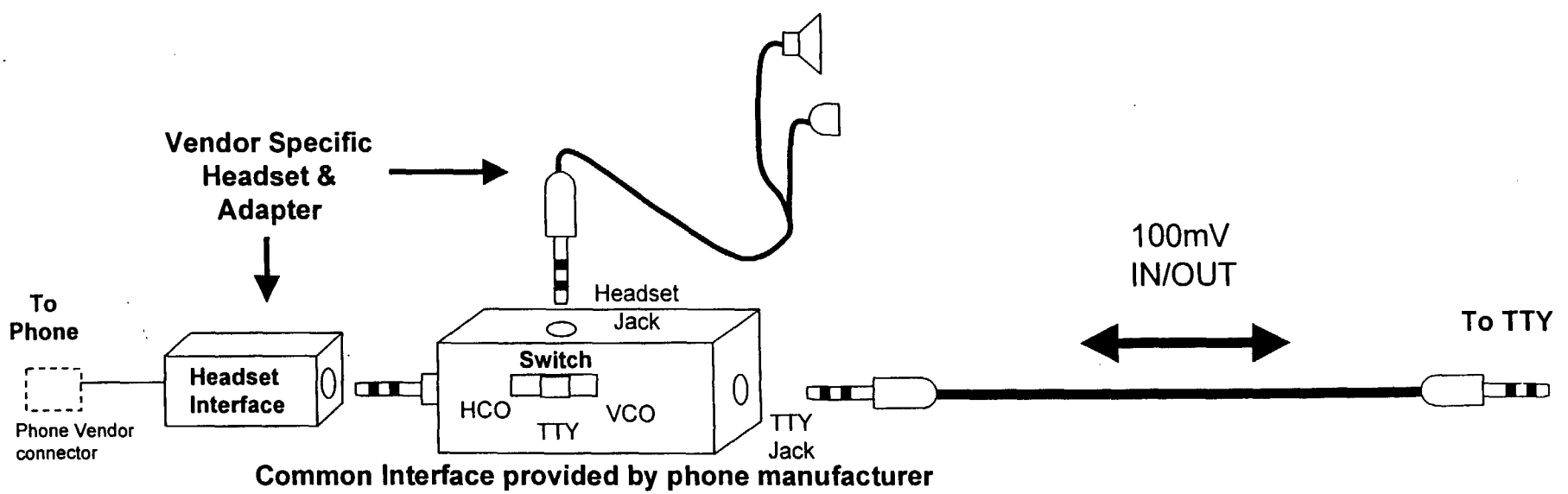
Past Discussion of possible Interface to TTY/TDD

- The Forum agrees that a common level is need at one point.
  - However, some want the levels standard with one cable, and others want an intermediate connection point.
  - VCO/HCO also needs to be connected some where in the interface.
- Who would provide this interface and ensure TTY's and a headset for VCO/HCO would connect properly?
- If standard levels are agreed upon for connection to a "Common Interface", why have both Phone and TTY vendors adjust to these levels at a separate interface and headset? Why not connect straight through to each others equipment?

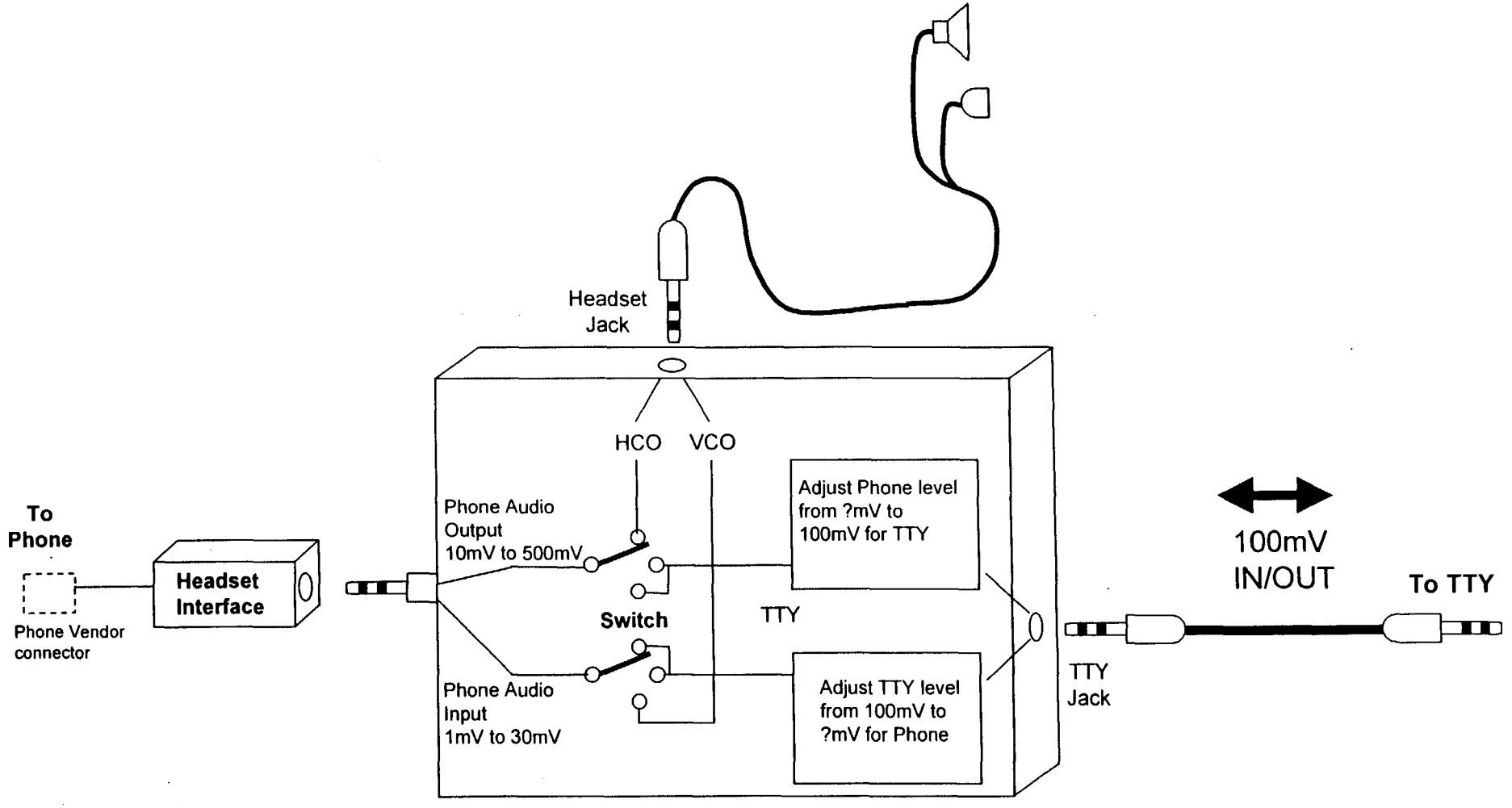


Proposed Common Interface

- The phone vendor's CURRENT headset and adapter would not change.
- The headset is already compatible to the phone and is usable for VCO/HCO.
- A standard level is used for the connection of the Common Interface to the TTY equipment.
- A switch on the Common interface allows for TTY, VCO, and HCO operation by using the phone manufacture's headset that is designed for the phone.
  - A switch allows for proper connection of Headset and/or TTY electrical load on interface. No push to talk button or disconnection of headset is needed.
- The Common interface is the only device that is solely used for TTY, VCO and HCO. No costly customized versions of the Phone manufactures Headset Adapter is needed.
- The phone manufacturer's headset adapter addresses most of the EMI issues.



Common Interface, close up

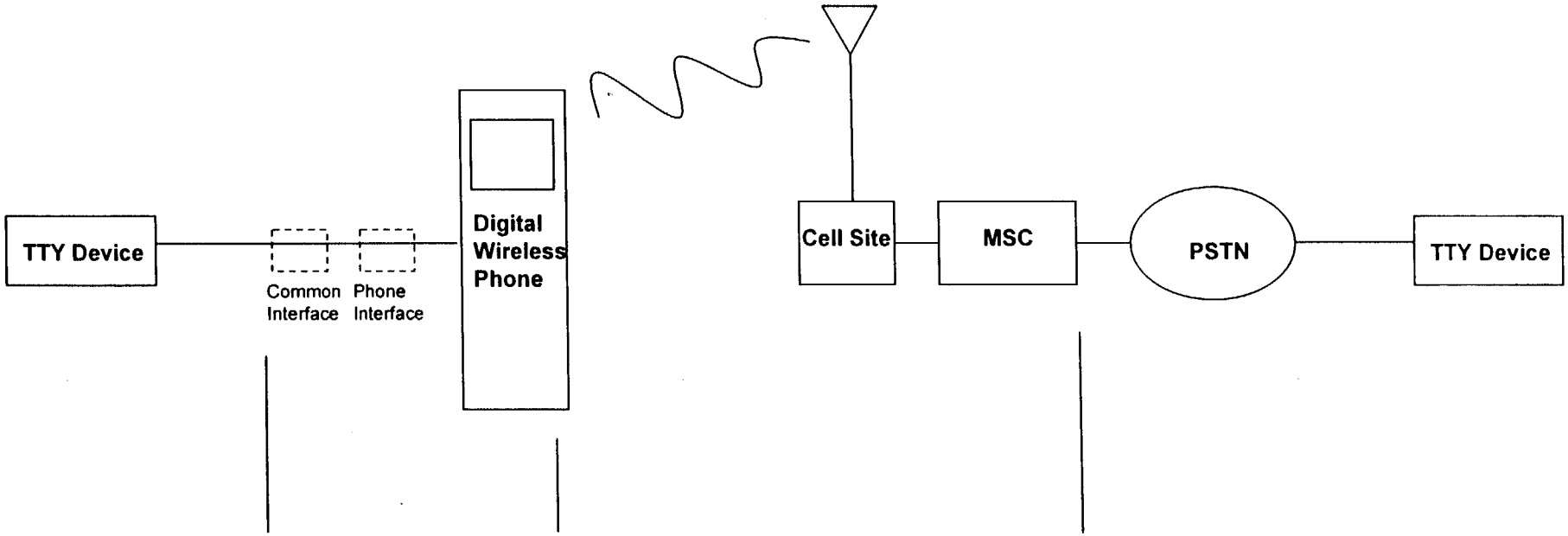


Common Interface provided by phone manufacturer

What's Needed from Manufacturers

- What is a usable input/output audio level from the Common interface to the TTY? 100mV?
- What are the optimum levels to drive the Digital Wireless phone's VOCODER and or other circuitry?
- What are the expected audio levels at the PSTN, and are they optimized for the needs of the receiving TTY? Can Wireless phones networks provide that level?
- Perform End to End testing for optimal performance of ALL equipment.
- Other issues?

End to End path



Wireless user to Land user

TTY TX Standard Audio level for Common Interface → Interface and Adapter level adjustment → Levels are modulated using Specific Technologies → Levels are sent to PSTN at optimal level for TTY RX. → Levels are received at optimal level for TTY RX.

TX Audio level=100mV **100mV ÷X** **Modulation=X** **Signal = -TBDdB?** **RX Signal = -TBDdB?**

Land user to Wireless user

TTY RX Standard Audio level from Common Interface ← Interface and Adapter level adjustment ← Levels are modulated using Specific Technologies ← Levels are sent from PSTN at optimal level from TTY TX. ← Levels are transmitted at optimal level to PSTN.

RX Audio level=100mV **100mV ÷X** **Modulation=X** **Signal = -TBDdB?** **TX Signal = -10dB**

APPENDIX L

Washington, D.C.
Septmeber, 1998

CTIA TTY Forum 7/98.09.08.E 6

TITLE:

A CDMA Data Solution for Reliable TTY/TDD

SOURCE:

Nikolai Leung
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ABSTRACT:

A white paper describing a data solution for supporting TTY/TDD over CDMA.

1 INTRODUCTION

The CTIA TTY Forum has generated a Standards Request Document for a data solution to support TTY. The following white paper explains how this data solution can be implemented in CDMA.

2 BASIC IDEA

TTY communication is a form of data communication – text characters are transmitted from one end to the other. Such communication can be reliably supported as a data service over digital wireless networks.

2.1 Modulation Tones

The TTY user's keyboard input is converted into a stream of binary digits (bits) that are transmitted, over the Public Switched Telephone Network (PSTN), to the receiver TTY device, where they are reassembled and displayed as text.

The PSTN is an analog channel that is designed to carry speech signals; it does not readily support the transmission of digital bits of information. To overcome this limitation, TTY devices modulate these digital bits into speech-like signals such as tones. Baudot modulation is one such form of signaling that uses a tone at 1400 Hz to represent a 0 and another tone at 1800 Hz to represent a 1.

2.2 Relaying Digital Data Over Digital Wireless Networks

Digital networks can relay data bits without any TTY modulation. There is no need for the TTY device to convert these bits into tones before entering the digital network. In fact, generating tones makes it more difficult for a wireless digital network to relay the data. Voice coders (vocoders), which send speech signals over the network, are designed for only speech signals. Digital voice systems are not able to handle tone-modulated data well.

2.3 Inter-Working Function (IWF)

On the network-side, wireless data services must be backward compatible with existing TTY devices on the Public Switched Telephone Network (PSTN) and at the E911 operator premises (PSAP). To support this backward compatibility, the network requires a function that will convert data bits received from the mobile into TTY tones for the PSTN and, in the reverse direction, convert TTY tones received from the PSTN into data bits sent to the mobile. Such a function is known as an Inter-Working Function (IWF).

The IWF is basically a pool of modems located between the wireless network and the PSTN to support wireless data services. Aside from TTY support, an IWF can also provide standard high-speed data modem service, fax service, and direct Internet access.

For CDMA network infrastructure throughout North America, employing an IWF in the network involves either a software upgrade to existing infrastructure, or the adding of a separate modem pool through a standardized interface (IS-658). In fact, service providers can go directly to IWF manufacturers to have this function deployed in their network.

2.4 Performance

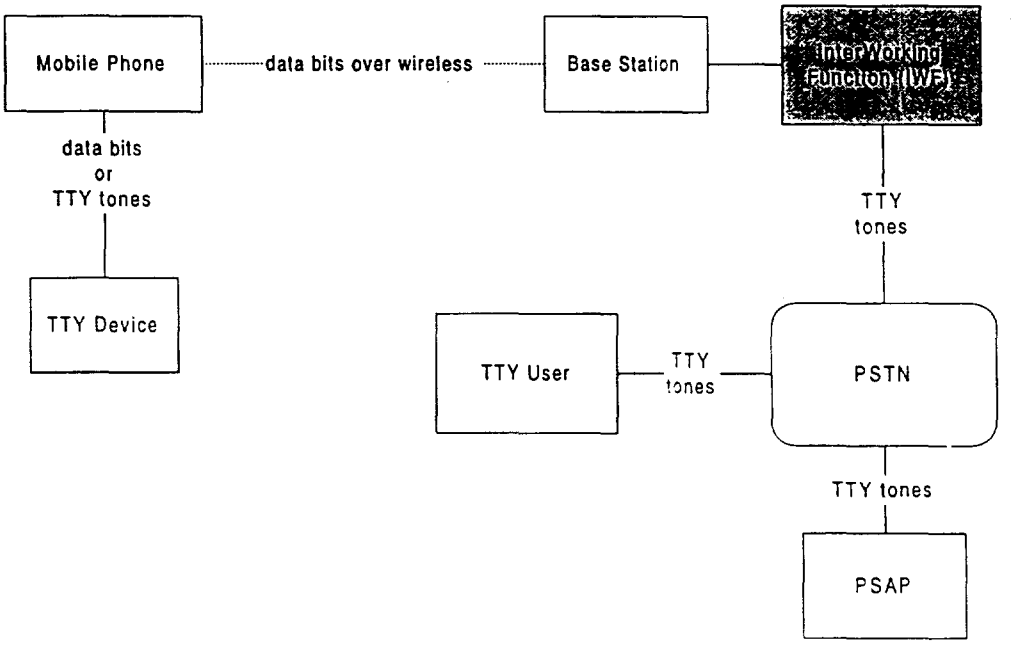
Relaying the TTY signal information over the wireless system using a data service allows the use of error correction protocols that can greatly reduce the chance of errors and improve the quality of communication. In fact, it can be shown that using a data service produces performance which is slightly better than wireline TTY communication. Some preliminary field tests of the TTY baudot data service show character error rates below 0.5%.

2.5 Other Data Services

Deployment of IWF's in a wireless network provides a number of other useful data services that can be made available to TTY and non-TTY users. The three basic services for CDMA are Circuit-Switched Data, Fax, and Packet.

Circuit-Switched Data Services allows the mobile user to dial into any modem on the PSTN using standard modem protocols (e.g., 14.4 kbps modulations) but without requiring the mobile user to have a modem. Fax service allows the mobile user to send and receive faxes in their mobile terminal. Packet Services allow the user direct connection to the Internet and all the services offered (e.g. web browsing, email, etc...) without any modems.

Wireless Data Service Model



3 DEVICE OPTIONS FOR MOBILE TTY UNITS

The following describes some possible choices for a mobile user to access the wireless TTY data service.

3.1 Smart Phone

This is a simple, highly portable, handheld device that would provided users TTY service without having to carry a separate TTY device.

A smart phone is a mobile unit that consists of a wireless phone integrated with both text input and display. Typical applications for such handheld devices are short messaging, checking email, fax service, and web browsing. Typical devices have small LCD screens and small keyboards or writing pads with fast character recognition for text exchange. For TTY applications, at the other end of the TTY conversation would be a regular TTY user on the PSTN, a standard PSAP, or another mobile TTY user.

Such devices will be commercially available for CDMA in the 1Q of 1999.

3.2 Direct Digital Connection

Laptops and TTY devices that support digital connections such as the TIA/EIA-232 interface can connect directly to the mobile phone (or sometimes through a small adapter cable). For TTY devices, the digital connection would completely by-pass the TTY modem function and in fact reduces the complexity of the TTY device. Some TTY manufacturers are already planning to have such digital connections available on their models. In fact, some models already have a digital access point which is currently being used for self-diagnostics. Other older TTY models may also be retrofitted to support a direct digital connection.

3.3 Analog Connections

For TTY devices that do not have a digital connection or can not be retrofitted to support one, some phones can provide the option for an analog connection via a 2.5mm or RJ-11 jack. To support this requires that a TTY baudot modem be implemented in the phone to allow conversion between baudot tones on the analog interface and digital bits sent over the wireless data link.

4 MODIFICATIONS

Following are the modifications required to implement a TTY Data Services for CDMA.

4.1 Standards

No changes have to be made to support TTY using data services. The existing IS-707 standard for CDMA data services has the necessary options to support TTY and any other V.18 modem.

4.2 Infrastructure

The IS-707 TTY baudot option has to be selected in the IWF. IWF manufacturers would have to upgrade the IWF software to support TTY baudot modems. CDMA IWF manufacturers have indicated a willingness to perform the necessary upgrades if required by carriers.

Carriers would then have to deploy at least one such IWF in each of their coverage areas.

4.3 Mobiles

Mobile manufacturers would have to implement data capabilities in their handsets. This would support TTY devices with digital interfaces.

For mobiles that will accommodate analog-only connections to TTY devices (e.g. 2.5 mm jack and RJ-11), the mobile must also have a TTY baudot modem. This allows the phone to convert between TTY tones on the analog connection and data bits over the radio link to the base station. Most phones use DSP chips for their vocoders and this TTY modem can be implemented using such a DSP, or a modified version of it.

In some cases, the mobile may be required to issue an IS-707 AT command to select TTY mode in the IWF.

5 SCHEDULES

CDMA mobiles with basic data services will be commercial in October of 1998. On the network side, some carriers have already deployed IWF's without TTY modems in their networks and are already conducting field trials in cities throughout the United States. Plans are to have commercial data services in these markets by the 4Q of 1999.

6 VOICE-CARRY-OVER (VCO)

Supporting VCO while running a data service requires that the users be able to switch back-and-forth between voice and data modes during a call. When TTY communication is used, the mobile and infrastructure use TTY baudot modems to communicate with the TTY devices; when VCO is in use, the mobile and infrastructure use vocoders (i.e., voice services) to communicate with the users.

Such switching of services during a call is technically feasible and is referred to as "Service Negotiation." However, implementing such a feature has significant impact on the network. The system must switch between the TTY modem function in the IWF and the vocoder function located in the base-station in the middle of a call and with minimal delay.

The schedule for support of such service switching is not clear.

7 SUMMARY

Standard CDMA data services can provide very reliable TTY/TDD service in the near-to-mid term. Handsets supporting basic service will be commercially available by October, 1998, and, with the necessary options, network support should be available in most markets by 4Q of 1999. Features such as VCO and analog TTY connections are also supportable but will require some more time to implement.

APPENDIX M

Portland, OR
August 17 - 21, 1998

TITLE:

Request for Project Number to Support Development of a Service Option to Provide Simultaneous Voice and Data Transport on a CDMA Fundamental Traffic Channel

SOURCES:

PHILIPS

Philips Consumer Communications
A Lucent Technologies and Philips Electronics Venture

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Ken Wells
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ABSTRACT:

This proposal describes a new Service Option, using the EVRC vocoder fundamental traffic channel, for support of simultaneous voice and dedicated user data encapsulated within a Rate Set 2 frame (14400 bps). By combining this unique use of the air interface with a data transport capability, low cost and highly reliable simultaneous voice and data services may be offered on CDMA wireless networks. It is envisioned that many call associated user data services can be made available using this service option.

RECOMMENDATIONS:

That this request be approved by Working Group I and forwarded to the TR45.5 Subcommittee for consideration.

GENERAL DESCRIPTION

Standards efforts, to date, have introduced a number of CDMA-based data service options for the fundamental traffic channel. The service options provide for the transmission of primary traffic, signaling traffic, secondary traffic, and for this contribution, a new category called dedicated user data traffic. The various voice and data (non-voice) multiplexed services are defined and specified independently within the confines of the air interface and the multiplex sublayer interface.

This contribution describes a new Service Option that operates on a Rate Set 2 frame and uses the EVRC vocoder to make available transport capacity in the air frame to carry dedicated user data. The new Service Option will operate on the fundamental code channel at 14400 bps. This proposal provides for data and messaging features that makes use of the unused portion in a Rate Set 2 frame resulting from using the EVRC vocoder, which normally operates in a Rate Set 1 frame at 9600 bps. In this manner, low cost simultaneous voice and data services may be offered on the mobile station fundamental traffic channel. The advantage of this technique is that a data transport capability can be guaranteed in combination with a full rate voice channel where the data can continuously and uninterruptedly be conveyed. For EVRC operating at full rate, a data transfer rate of 12.8 kbps non-voice mode and a 4.4 kbps voice mode service can be provided. When operating at half rate, corresponding data rates of 6 kbps and 2 kbps can be realized. Applications such as interactive messaging/paging, Computer Telephony Integration (CTI), and web chatting can easily be accommodated simultaneous with a high quality voice service. With this new Service Option, it should also be possible to provide TTY/TDD with Voice Carry Over calling capabilities over a single CDMA fundamental traffic channel.

APPENDIX N

Portland, OR
August 17 - 21, 1998

TR45.5.1/98.08.17.22

TITLE:

A Proposed Method to Improve TTY Reception Over Wireless Links Without Requiring Standards Changes

SOURCES:

Philips Consumer Communications

A Lucent Technologies and Philips Electronics Venture

Dr. Raziel Haimi-Cohen
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(732) 878-8693 fax
rhaimicohen@pcc.lucent.com

ABSTRACT:

This proposal describes a methodology which can provide nearly error free transmission of TTY FSK Baudot text over the CDMA digital air interface. The technology presented in this proposal can be implemented in the present North American CDMA network without requiring Standards changed. This technique can be readily implemented to support signaling transport over the voice channel, thus provide a viable short-term solution for TTY/TDD communications.

RECOMMENDATIONS:

That this proposal be considered and adopted by TR45.5.1 as a viable method for reliable transmission of TTY signaling. It is suggested that this contribution be forwarded to Subcommittee TR45 for consideration as a method for providing compliance to the governing FCC mandate.

CONTENTS

TABLE OF FIGURES

1. BACKGROUND: TTY FOR WIRELESS TELEPHONY

Section 255 of the Telecommunications Act of 1996 mandates that telecommunications service providers and telecommunications equipment manufacturers make their services and equipment accessible to those with disabilities. Specifically, rule (47 CFR 20.18) requires that licensees subject to this section must be capable of transmitting 911 calls from individuals with speech or hearing disabilities through means other than mobile radio handsets; e.g., through the use of Telecommunications Device for the Deaf (TDD/TTY). This provision is already in force for analog licensees. Licensees operating digital systems have until October 1, 1998 to provide access. The industry is now preparing to request some extension to this deadline, but it is clear that any method which requires a serious change in Standard will not be suitable.

Several coding schemes are used for TTY. The most common one is Baudot code of 45.45 character per second. In fact it seems that virtually all TTY terminals support this code as a default. This report will consider only the Baudot code, assuming that transmission of Baudot code is necessary and sufficient to meet the FCC mandate.

1.1 TECHNICAL ISSUES

Two issues must be addressed when considering TTY signal transmission over wireless telecommunications networks:

- The distortion to the TTY signals caused by the wireless channel.
- Providing an interface between the cellular handsets and a TTY terminal.

Both of these issues have been addressed in analog wireless communication. Several mobile handset manufacturers offer interface gear between their handset and RJ11 port and the distortion caused by analog wireless communication seems to be generally acceptable.

This document will consider only the first problem, assuming that the second will be resolved in a similar way as in the analog case.

In digital wireless communication the channel distortion are significant, to the point that prevents practical communication. There are two causes for this problem:

Source coding distortion: It would seem that the distortion introduced by the speech coder itself, running at full rate, is small enough to allow acceptable recognition of the decoded TTY signal. However, rate determination algorithms in CDMA, [or, in the case of TDMA - discontinuous transmission (DTX) algorithms], may determine that the TTY constant envelope signal is "background noise" and thus force the encoder to transmit it at 1/8 rate [or as comfort noise, respectively]. In those cases the TTY signal will be distorted to the point that no reliable detection can be made. Furthermore, a noise suppression algorithm such as those used in EVRC, may identify that the TTY signal as noise and suppress it, and filter out the frequency components of the Baudot FSK signal.

Channel Distortion: Ahmed Tarraf, of Lucent Technologies, determined that the main cause of errors in CDMA communication is frame errors. A frame error is detected by using CRC; in such a case the frame is ignored and error concealment is applied. This will most likely cause an error in the FSK scheme which will lead to a character error. Since the normal operational frame error rate in CDMA network is around 1-2% and there are about 8-9 frames in one Baudot character, this leads to an unacceptable character error rate of 8-16%.

1.2 PROPOSED APPROACHES

FCC has required the industry to provide a solution for TTY over digital wireless networks. In discussions within the industry, three types of solution are being offered:

Short-term solution which does not require any standard modification

Mid-term solution which may include a change in speech or channel coding standards.

Long-term solution which may replace the Baudot coded by a more robust data communication protocol.

2. PURPOSE

The purpose of this document is to propose a short-term solution to the problem of transmission of Baudot signals over a wireless network.

3. DESIGN PHILOSOPHY

3.1 DESIGN CONSTRAINTS

1. The solution shall be compatible with the existing base of TTY devices, both in the land-line side and in the mobile side.
2. The solution may require changes in the mobile and network, but it will not require standards changes. In particular:
   - For normal speech signals a TTY-modified mobile or base station would function the same as its non-modified counterpart.
   - For TTY communication; if a non-TTY compatible base station communicates with a TTY compatible-mobile station, or a TTY base station communicates with a non-compliant handset, the performance should be better than TTY communication between both non-compliant base stations and handsets.
3. The solution should be relatively simple, in order to allow timely implementation. In particular, the implementation of a Baudot signals detector, a Baudot decoder and a Baudot encoder is considered simple enough to implement in the handset or in the infra-structure in a relatively short time. The Baudot code is a very basic FSK code and its handling should not be a problem with the computing resources typically used in wireless communication.

3.2 TRANSMIT END PRE-PROCESSING

TDD/TTY communications standards allows the user to switch back and forth from between text and voice modes; i.e., VCO/HCO, without any signaling to notify the transmission equipment of the change. In principle, we may add a requirement that the TTY terminal itself should produce such a signal, when it is transmitting Baudot signals. However, such a requirement would be difficult to justify at the mobile station and certainly unacceptable for the land-line side. Furthermore, if the call is initiated by the land-line side, there is no way that a request for a special service option can be made when the call is established, because the calling land-line telephone set "does not know" that it is connected to a TTY terminal. Therefore, to the extent that any solution requires special action for TTY signals on the transmit end, the transmit side should include a detector for Baudot signals to enable that action.

It would seem that some special action should be required at the transmitting end in almost any solution:

- In solutions based on transmitting the TTY signal via the vocoder, the TTY detector will facilitate the disabling the noise suppression and forcing full rate.
- In solutions based on transmitting the TTY signal as a special type of data (long term solutions), there should be a modem which converts the TTY input signal into a bit stream, if a TTY signal is present. Such a modem is inherently a detector, since it is supposed to produce no output when there is no TTY input signal.

The TTY signal in the transmitting end is not corrupted by the wireless transmission, therefore the implementation of a reliable TTY detector is straight forward.

3.3 THE REPEATER CONCEPT

The solution proposed in this section is implemented in the receiving end, past the speech decoder. It is a *repeater* which gets as its main input a corrupted TTY signal and provides as output a clean version of the same signal. The main advantage of this repeater over an external TTY device is that its input consists not only of the decoded speech frames but also of the frame error indicator (FER) from the channel and speech decoder. The output of the repeater consists of a "cleaned" TTY signal and, in addition, a detection flag which indicates whether the signal is a TTY signal or not.

The repeater may be viewed as a pair of a receiver and a transmitter back-to-back. In our case, the transmitter is fairly simple, while the receiver is supposed to detect the Baudot signals and handle the channel distortions. So in the following we will concentrate on the design of the receiver, assuming that the transmitter design is straight forward and its performance is ideal.

The detection flag output should be used by the system to determine whether to pass the speech decoder output to the audio circuits unchanged or to use the output of the Baudot repeater (see Figure 1).

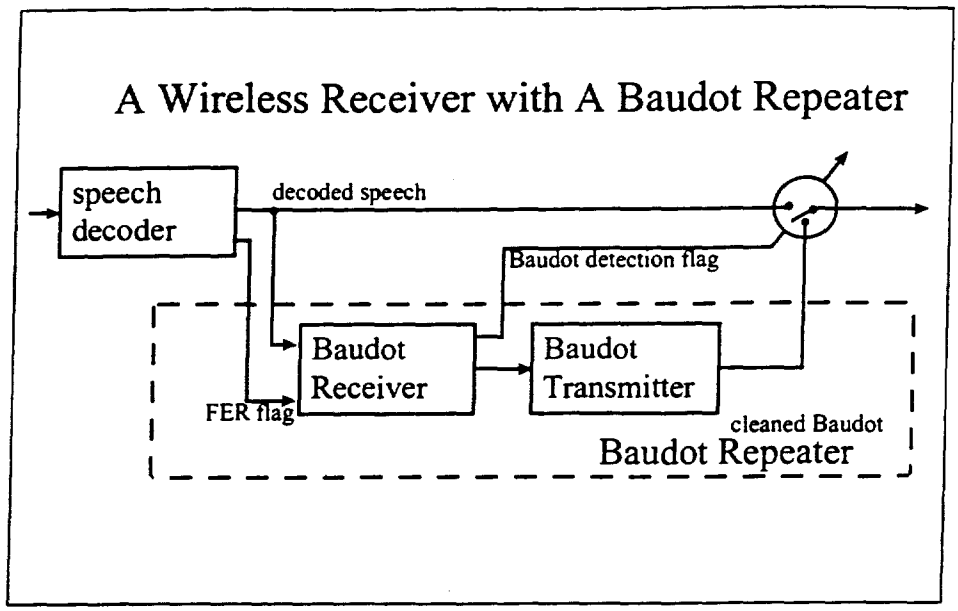

Figure 1: Baudot repeater integrated in a wireless receiver

4. HANDLING FRAME ERRORS

We assume that the incoming signal has not been destroyed at the transmitting end by a noise suppresser or a rate determination algorithm. In that case, if there are no frame errors the operation of the receiver is quite simple. The main issue is that of processing bad frames.

It should be noted that Baudot bits are 22 ms in duration while the speech frames are only 20 ms in length. Therefore, any isolated frame error does not conceal a complete Baudot bit, as can be shown in Figure 2. By examining this figure, one can clearly see that by using simple logic one can deduce the missing parts of each bit from the Baudot bit time line and from the part of the bit that is not within the bad frame; that is, the part that is included in the preceding or the following frame.

If there are two or more consecutive bad frames, then some bits may be completely hidden by bad frames. If the hidden bit is a start or a stop bit, we can still determine the character correctly. If the hidden bit is a data bit, then its value had to be guessed with 50% probability of error. Thus, the character error rate is proportional to the frequency of bursts of more than one frame errors.

It should be noted that for a given frame error rate, the presence of burst of more than 2 bad frames actually decreases the character error rates, because as the bursts get longer, their frequency, at a given frame error rate, becomes smaller.

The duration of the data bits in a Baudot signals is 5.5 frames. In the worst case, where all bad frames come in well separated pairs, the probability of a pair of bad frames is 0.5-

1%, hence the probability of a bad frame within the data bits is roughly 2.5-5%, which leads to a probability of 1.25-2.5% of character errors. This error rate would seems to be very close to the acceptable. Furthermore, the assumption that all bad frame come in disjoint pairs is highly unrealistic: many of the bad frames are isolated, while many others come in bursts of more than 2 bad frames. Therefore, the realistic probability of a character error is much smaller and well within the 0.5-1% CER range as suggested by the hearing impaired community.

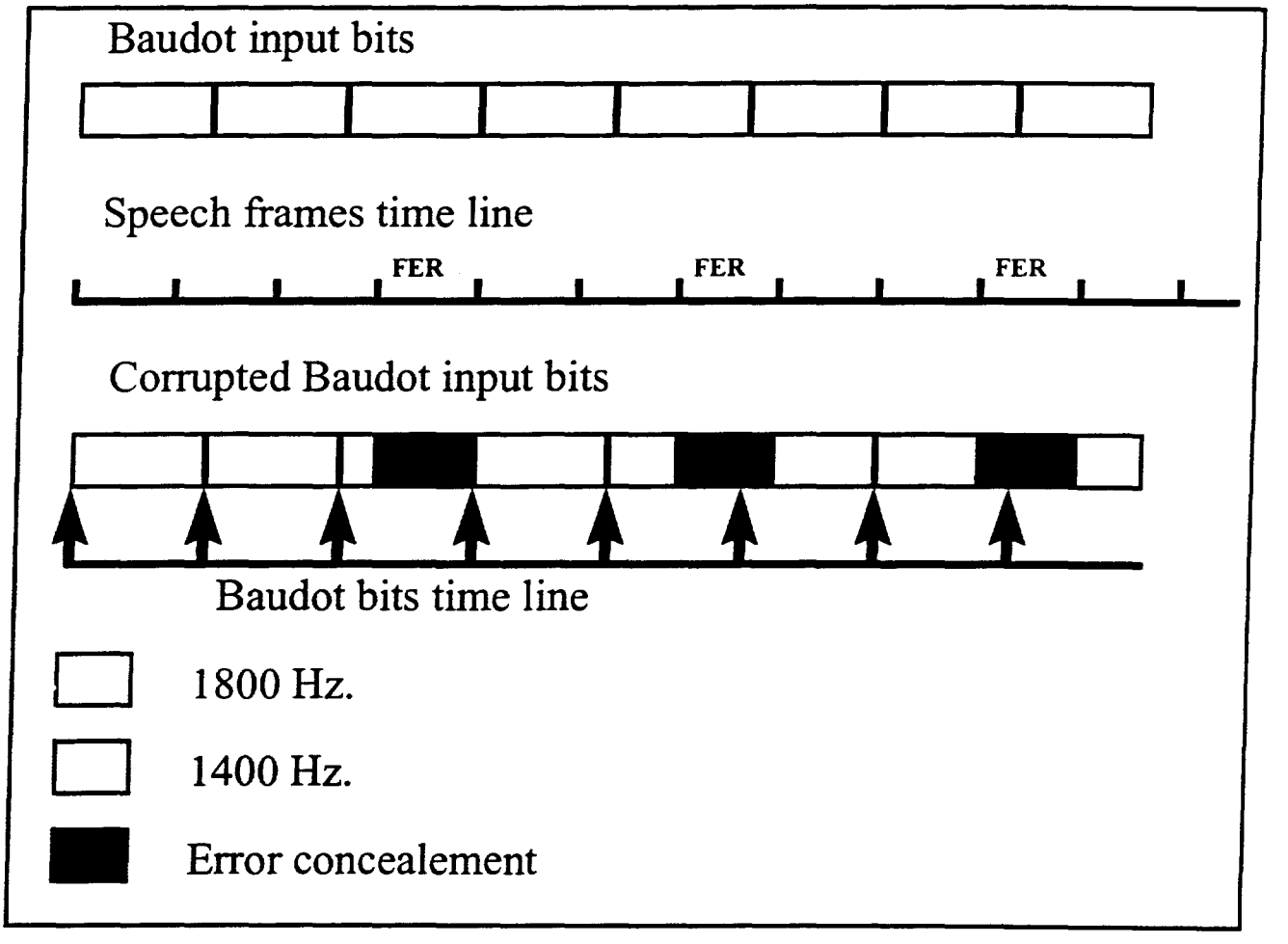

Figure 2: A schematic view of the effect of frame errors on Baudot reception.

APPENDIX O

TTY Forum - 1178.07.03.01

AMERIPHONE
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Sept. 3, 1998

Mr. Ed Hall
Chair - CTIA Forum
1250 Connecticut Ave. NW - Suite 200
Washington, DC 20036

Subject: VCO, HCO and Wireless Handset

Dear Ed,

Previous CTIA Forums recommended the use of a 2.5 mm plug adapter for interfacing between a wireless handset and a TTY. Ameriphone endorses this approach and supports the recommended interface signal and impedance level.

Various participants in the last CTIA Forum also strongly suggested that VCO and HCO applications using a wireless handset are just as important as TTY or voice calls. They wanted CTIA to do whatever it can to promote easy access for these users.

I would like to echo this subject matter with the following:

Since plugging in a 2.5 mm plug to a wireless handset normally disconnects its microphone and receiver. Signals are now being routed to either a headset or a TTY machine via the 2.5 mm adapter. This is perfectly acceptable for TTY or voice application.

However, this approach may not be most ideal for VCO and HCO applications because each of these two applications requires the use of either a microphone or a receiver. It has been assumed or suggested that a walkman style headset be used on the TTY for these applications. This is very reasonable.

In addition, the user should be able to selectively enable the handset microphone or receiver for VCO or HCO use. The key advantage here is convenience because, with this option, the user always has a backup in the handset.

A selectively enabled microphone / receiver is also very useful in trouble shooting a bad connection between the handset and TTY.

Sincerely,

Peter Lee
V-P Engineering

APPENDIX P

CDG Contribution to CTIA TTY/TDD Forum 6

July 21, 1998

The CDMA Development Group (CDG) has put in place an initiative to help the wireless industry meet the requirements of the FCC mandate for providing E911 capability to the hearing and speech impaired. The purpose of this contribution is to provide a brief summary of the CDG's efforts on this topic, to outline the CDG's position on one of the key performance parameters for E911 TTY/TDD, and to call on the members for the wireless and hearing impaired industries to clarify certain issues prior to the conclusion of the CTIA TTY/TDD Forum 6 so that solutions can be developed as soon as possible.

The purpose of the CDG's TTY/TDD initiative is to ensure **cdmaOne™** meets the FCC's TTY/TDD E911 mandate by:

- Sharing test results to assess capability
- Discussing and cataloging candidate solutions
- Outlining steps needed to implement solutions

The CDG, either directly or through its members, will continue to participate in the efforts of the CTIA and will maintain an open dialogue on this critical topic.

Performance Requirements

The CDG has discussed the issue of character error rate performance in meeting the FCC mandate. This issue has been discussed in past CTIA Forums.

The CDG has adopted the following character error rate requirements and recommends members of the CTIA Forum do the same:

- 3% character error rate in the short term (by October 1, 1998)
- 1% character error rate in the long term (date to be determined)

Issues Requiring Clarification

There are a number of other issues discussed by both the CTIA Forum and CDG that require clarification in order to develop a solution to the FCC mandate more expeditiously. The CDG requests that the following questions be answered by the conclusion of the CTIA TTY/TDD Forum 6:

1. Must both RJ11 and acoustic interfaces be supported? Is a 2.5mm interface sufficient?
2. Is an RS-232 interface solution acceptable?
3. Is it acceptable to retrofit TTY/TDD terminals provided there is no cost for this to the user?
4. Is a smart phone (a phone integrated with text input and display) solution acceptable?

TITLE:

CDMA Development Group Contribution to CTIA TTY Forum 6, July 21, 1998

SOURCE:

CDMA Development Group
650 Town Center Drive, Suite 820
Costa Mesa, CA 92626
Contacts: Jim Takach 714-545-5211
Nikolai Leung 202-530-3927

NOTICE

APPENDIX Q

CTIA
Cellular Telecommunications Industry Association

Andrea D. Williams
Assistant General Counsel

September 8, 1998

Mr. Ed Hall
Ms. Mary Madigan
Co-Chairs, Wireless TTY Forum
c/o Gallaudet University
Kellogg Conference Center
800 Florida Avenue, NE
Washington, DC 20001

Dear Members of the Wireless TTY Forum:

At Wireless TTY Forum 6,[1] consumer advocacy groups representing the deaf and hard of hearing submitted a document titled "Consumer Approved Criteria for Acceptance of 'One Phone Model Per Service Provider as of October 1' Proposal" ("Consumer Criteria Document").[2] The purpose of the document is to stimulate discussion and solicit the views of the wireless telecommunications service providers and equipment manufacturers participating in the Wireless TTY Forum. On behalf of its members, the Cellular Telecommunications Industry Association ("CTIA")[3] respectfully submits its comments to the criteria set forth in the Consumer Criteria Document.

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[1] The Wireless TTY Forum 6 was held on July 20-21, 1998 in Washington, D.C.

[2] The Proposal states that each wireless carrier would provide by October 1, 1998, at least one compatible digital phone model, at a reasonable price, for each digital technology that the carrier offers. Manufacturers of CMRS equipment have a separate obligation under Section 255 of the Communications Act with respect to the accessibility or compatibility of their products for TTY users.

[3] CTIA is the international organization of the wireless communications industry for both wireless carriers and manufacturers. Membership in the association covers all Commercial Mobile Radio Service ("CMRS") providers, and includes forty-eight of the fifty largest cellular and broadband PCS

The varied tests results, a significant breakthrough isolating one source of the problem for one digital technology, and the need for TTY performance standards suggest that further research needs to be conducted in order to provide technically feasible solutions for TTY users to access 9-1-1 over digital wireless systems. Hence, compliance by October 1, 1998, for a short-term solution for some digital technologies may be technically impossible.

While the "One Phone Model per Service Provider" proposal is moot with respect to the October 1, 1998, compliance date, some of the listed criteria, *i.e.*, Criteria 1.0 and Criteria 4.4, provide useful guidance to wireless service providers and manufacturers in their efforts to provide technically feasible solutions for TTY users to access 9-1-1 over digital wireless systems. Accordingly, CTIA has addressed these criteria in a proposed workplan of the wireless telecommunications industry for TTY access over digital wireless systems.[4]

Many criteria, however, implicate marketing, advertising and customer care issues as well as pending regulatory issues before the Federal Communications Commission.[5] The Wireless TTY Forum is not the appropriate venue to address such issues, because the Forum's primary focus is to seek and develop technically feasible solutions for TTY users to access 9-1-1 over digital wireless systems. Many representatives of wireless carriers and manufacturers that attend the TTY Forum meetings do not have the authority to bind their respective companies nor the wireless industry with respect to these issues. Moreover, these issues transcend the FCC's requirements governing access to 9-1-1 with

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providers. CTIA represents more broadband PCS carriers and more cellular carriers than any other trade association.

[4] CTIA has drafted a proposed workplan of the wireless telecommunications industry for TTY access over digital wireless systems. On September 4, 1998, CTIA sent a copy of the proposed workplan to representatives of the consumer advocacy groups, the TTY manufacturers and representatives of public safety organizations seeking their input. The draft document is offered to stimulate discussion and solicit views of the respective stakeholders of the TTY Forum.

[5] See Criteria 2.0 through 5.0 of Consumer Approved Criteria for Acceptance of "One Phone Model Per Service Provider as of October 1" Proposal. Attached hereto as Appendix A.

TTY devices over wireless systems, and may implicate the wireless industry's obligations under Section 255 of the Communications Act of 1934, as amended. Therefore, it is more appropriate to address such issues in the broader context of Section 255.

The wireless industry is committed to working with consumer advocacy groups representing the deaf and hard of hearing to provide viable and practical solutions for TTY access over digital wireless systems. Accordingly, CTIA extends an invitation to the drafters of the Consumer Requirement Document to meet with CTIA's senior staff to address these issues in the context of CTIA's inter-disciplinary approach to accessibility under Section 255.

Thank you for the opportunity to address the Forum. CTIA looks forward to meeting with the drafters of the Consumer Requirement Document in the near future.

Sincerely,

Andrea D. Williams

Andrea D. Williams
Assistant General Counsel

Attachment
cc: Dan Phythyon
Elizabeth Lyle
Dale Hatfield
John Cimko
Pam Gregory

APPENDIX A

Consumer Approved Criteria for Acceptance of "One Phone Model Per Service Provider as of October 1" Proposal

Draft July 20, 1998

1.0 Digital Access

1.1 The nominally accessible model will use the digital wireless system; that is, it will not achieve compliance by defaulting to analog.

1.2 Each service provider must provide one accessible model for each digital technology supported by that service provider.

1.3 Voice-through, VCO and HCO must be supported. (This simply means that the call must be able to handle voice and TTY alternating on a call.)

2.0 Time period

2.1 One-model-per-provider to be acceptable for one year, after which other models supported must be accessible.

3.0 Availability of model

3.1 Model and related adapters should be easily and quickly obtainable, in line with other customers' experience when purchasing.

3.2 Special ordering from the supplier/vendor should not be required..

4.0 Features, functions, and price

4.1 Features, functions, and price of the phone should be representative of a cross section of all digital phones supported by the service provider, and should not be limited to only those features, functions or price available on the lowest- or highest-end digital phones.

4.2 Adapters and extra parts must not incur additional expense over cost of phone.

4.3 Customer must not be required to pay for retrofitting TTY to fit the phone model

4.4 Essential features include

4.4.1 Model must have built-in vibrating ring signal or come with remote vibrator. (If handsfree adapter is plugged in, phone should still vibrate.)

4.4.2 Volume control

4.4.3 Ability to pass through sounds on the line to the TTY (so that the user can monitor ring, busy, etc.)

4.4.4 A visual indication when call has been disconnected.

5.0 Customer Information

5.1 A single point of contact should be identified for obtaining customer information about digital telephones and their compatibility with TTYs. Contact must be available via fax and e-mail; and where accessible by voice phone, direct access by TTY should also be provided.

5.2 Service providers will advertise the availability of an accessible model in consumer publications reaching deaf and hard of hearing TTY users.

5.3 Television ads for digital wireless service shall be captioned.

5.4 If there are account problems, some service providers give access only for calling to the accounting department (e.g., a thee-digit number). Such numbers must be TTY-accessible.

APPENDIX R

September 10, 1998

To: TTY Forum

Fr: Consumer Representatives

The CTIA has said that most of the consumer criteria previously submitted were not usable by the TTY Forum because the criteria covered marketing and distribution as well as design. Marketing and distribution issues for a possible "one-phone-model-per-technology" short-term plan will be taken up with CTIA's senior management, as suggested by them.

This contribution is a new set of criteria to address only functional characteristics of the solutions. The new criteria also reflect new information from the Forum since the first list was drawn up. It is intended to cover any solution.

1. The character error rate should approximate that of AMPS, which has been demonstrated at <1% for stationary calls. More research on AMPS performance with TTY would be useful to assist in specifying a range of conditions.

2. The TTY caller must be able to visually monitor all aspects of call progress provided to voice users. Specifically, the ability to pass through sounds on the line to the TTY (so that the user can monitor ring, busy, answered-in-voice, etc.) should be provided.

3. There must be a visual indication when the call has been disconnected.

4. A volume control should be provided.

5. The TTY user must have a means of tactile (vibrating) ring signal indication.

6. The caller must be able to transmit TTY tones independent of the condition of the receiving modem. (This is to permit baudot signalling by pressing a key, to let a hearing person know that the incoming call is from a TTY.)

7. The *landline* party's TTY must not require retrofitting in order to achieve the desired error rate.

8. The *wireless* party's TTY may require retrofitting, or a new model TTY to be developed, or the use of a portable data terminal such as a personal digital assistant.

9. VCO and HCO should be supported where possible.

10. Reduction of throughput (partial rate) on Baudot is highly undesirable and should not be relied upon to achieve compliance (see #7). It may be useful as a user-selectable option to improve accuracy on a given call.

11. Call information such as ANI and ALI, where provided in wireless voice, should also be provided for TTY calls.

12. The solution need not support little-used or obsolete TTY models, but in general should support the embedded base of TTYs sold over the past ten years. The landline equipment supported must not be limited to that used in Public Service Answering Points (911 centers).

13. Drive conditions must be supported, again using AMPS as a benchmark.

APPENDIX S

September 11, 1998

Mr. Daniel Phythyon
Chief, Wireless Telecommunications Bureau
Federal Communications Commission
2025 M Street, NW, Room 5002
Washington, DC 20554

Re: ***Ex parte*** **Communication**
Revision of the Commission's Rules to Ensure
Compatibility with Enhanced 911 Emergency Calling Systems
CC Docket No. 94-102

Dear Mr. Phythyon:

Since September 1997, the wireless telecommunications industry (wireless telecommunications carriers and equipment manufacturers), manufacturers of TTY equipment, emergency and relay service providers (9-1-1 and TRS), and consumer organizations that represent individuals who are deaf and hard-of-hearing ("Stakeholders") have undertaken intensive collaborative efforts through the Wireless TTY Forum ("TTY Forum") to provide viable solutions for TTY users to access 9-1-1 over digital wireless systems. These efforts have been documented in the Quarterly Status Reports submitted to the Commission on April 10, 1998, and July 10, 1998.[1] Based on the facts presented below and the documented test results in the Status Reports, CMRS carriers offering digital wireless services will not be able to comply with the FCC's rules governing TTY access to 9-1-1 over digital wireless systems by October 1, 1998.

In an effort to focus research efforts and resources to meet the Commission's October 1, 1998, compliance date, the TTY Forum has focused on trying to find acceptable short-term solutions while work continues to develop long term solutions, *i.e,* data solutions, for TTY users to access 9-1-1 over digital wireless systems. For short-term solutions, the TTY Forum has primarily concentrated on "backward" compatibility, *i.e.,* attempting to transmit 45.45 baud Baudot signaling over digital wireless systems.[2]

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[1] See In the Matter of Revision of the Commission's Rules To Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, Quarterly Status Reports filed April 10, 1998, and July 10, 1998("April Quarterly Status Report" and "July Quarterly Status Report"). A Supplemental Status Report will be filed prior to September 30, 1998, and will include information and test results provided from TTY Forum Meetings 6 and 7.

[2] April Quarterly Status Report at 3; July Quarterly Status Report at 1-3.

While the TTY Forum has identified the technical challenges associated with backward compatibility, it recognizes that the majority of TTY users still rely on TTY machines equipped with 45.45 baud Baudot signaling as their primary mode of communication.[3] However, varied test results, a significant breakthrough isolating one source of the problem for one digital technology, *i.e.*, CDMA technology, and the need for TTY performance standards suggests that further research needs to be conducted as well as the development of technical guidelines and standards in order to provide both short-term and long-term technically feasible solutions.

It appears from the discussions at the TTY Forum that manufacturers are still in the testing phase of developing technically viable solutions which will allow TTY users to access 9-1-1 over digital wireless systems. There is every indication that no manufacturer of wireless digital handsets will have a commercially available product[4] by October 1, 1998. Without the appropriate equipment, it is technically and fundamentally impossible for wireless carriers to comply with the Commission's rules governing TTY access to 9-1-1 over digital wireless systems by October 1, 1998.[5]

The TTY Forum has provided preliminary test results and demonstrations on several potential methods for addressing "backward" compatibility between TTYs and the different wireless digital technologies. The goal is to achieve "backward" compatibility and at the same time minimize the character error rate, particularly in emergency situations. However, a certain character error rate is inherent with wireline and wireless, both analog and digital technologies, and TTY devices. The Quarterly Status Reports and the forthcoming Supplemental Status Report document and explain the activities undertaken by various participants of the TTY Forum not only in trying to isolate the source of the problem but also the factors that contribute to the variance in the character error rates.

The TTY Forum developed a uniform test script that manufacturers representing various digital technologies and at least one TTY manufacturer have used in their testing. Test results showed a wide variation in the character error rates among the various digital wireless technologies. Moreover, there is concern that the variation in test results may be partially the result of inconsistent test methods, inconsistent methods of evaluating test results among the various manufacturers, and inconsistent performance of various TTY equipment.

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[3] April Quarterly Status Report at 3-4.

[4] In its discussions with CTIA concerning the TTY Forum, the Wireless Telecommunications Bureau staff has indicated that commercially available means the product can be sold or made available to the customer at point of sale or shortly thereafter.

[5] See 47 C.F.R. § 20.18(c).

At the recent TTY Forum Meeting held September 8-9, 1998, the TTY Forum co-chair noted that while the initial effort of the TTY Forum was not to produce tests results, the Forum has moved to the point where testing is critical to gathering information and a standardized test plan should be developed. Accordingly, the TTY Forum in conjunction with the wireless digital technology groups are developing a consistent test method and method of evaluating test results.

In the event that equipment would not be commercially available by the FCC's October 1, 1998 compliance date, CTIA agreed at the July 1998 TTY Forum Meeting to establish an Ad Hoc Working Group to develop a proposed workplan with scheduled milestones.[6] In anticipation of the CTIA Ad Hoc Working Group meeting in September 1998, CTIA have had several discussions with its members concerning an approach to the TTY compatibility issues. Attached is a proposed workplan that CTIA has drafted with input from its members. While the proposed workplan was recently provided to the other Stakeholder groups, they have not had an opportunity to review and discuss the proposal within their respective groups. It is anticipated that the Ad Hoc Working Group will meet by the end of September 1998. *It is important that the Commission understands that the proposed workplan of the wireless telecommunications industry is a draft document and does not necessarily reflect the views of the consumer advocacy groups, TTY manufacturers or the PSAP organizations. Most important, the draft document needs the input from these Stakeholder groups before it is finalized.* Accordingly, additional time is needed for such discussions, finalization of a workplan, and implementation of that workplan.

Based on the foregoing, CTIA, with the support of PCIA, respectfully requests that the Wireless Telecommunications Bureau pursuant to its delegated authority grant an additional three-month extension from October 1, 1998, to January 1, 1999, for CMRS carriers to comply with Section 20.18(c) of the Commission rules.[7]

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[6] CTIA has requested each Stakeholder group to provide two representatives to the CTIA Ad Hoc Working Group. In addition to CTIA and PCIA representing the wireless industry, there will be one technical representative from each wireless digital technology group. The composition of the Ad Hoc Working Group will be: Consumers – 2, PSAPs – 2, TTY manufacturers – 2, Wireless Industry - 2 (CTIA & PCIA) , CDG (CDMA) – 1, GSM North America (GSM 1900) – 1, UWCC (TDMA) – 1, and iDEN – 1.

[7] Based on the discussions of the TTY Forum, there is the likelihood that the equipment necessary to provide TTY access to 9-1-1 over digital wireless systems will not be commercially available until after January 1, 1999. Accordingly, CTIA, with the support of PCIA, will also seek an additional extension of time from the full Commission.

If you should need any additional information concerning this matter, please do not hesitate to contact us.

Respectfully submitted,

Andrea D. Williams
Assistant General Counsel
Cellular Telecommunications Industry Association

Mary Madigan Jones
Vice President of External Affairs
Personal Communications Industry Association

Attachment (1)

cc: Dr. Dale Hatfield
Ms. Elizabeth Lyle
Ms. Meryl Icove
Ms. Pam Gregory
Mr. John Cimko
Ms. Nancy Boocker
Mr. Marty Liebman

PROPOSED WORKPLAN OF THE WIRELESS TELECOMMUNICATIONS INDUSTRY FOR TTY ACCESS OVER DIGITAL WIRELESS SYSTEMS

Since September 1997, the wireless telecommunications industry (wireless carriers and phone manufacturers), manufacturers of TTY equipment, emergency and relay service providers (9-1-1 and TRS), and consumer organizations that represent individuals who are deaf and hard-of-hearing ("Stakeholders") have undertaken intensive collaborative efforts through the Wireless TTY Forum to develop short-term and long-term solutions for TTY users to access 9-1-1 over digital wireless systems. While the TTY Forum's primary focus to date has been to find an acceptable short-time solution by the FCC's October 1, 1998, compliance date, the varied test results, a significant breakthrough isolating one source of the problem for one digital technology, and the need for TTY performance standards suggest that further research needs to be conducted in order to provide both short and long term technically feasible solutions. Hence, compliance by October 1, 1998, for a short-term solution for some digital technologies may be technically impossible.

The wireless industry is committed to continuing intensive collaborative efforts to provide viable and practical solutions for TTY access over digital wireless systems not only for 9-1-1 purposes but also to meet the industry's obligations under Sections 225 and 255 of the Communications Act of 1934, as amended. The wireless industry acknowledges that it cannot resolve this issue in a technical vacuum, and that the wireless industry must continue to work cooperatively with TTY manufacturers, the appropriate consumer organizations and organizations representing public safety answering points ("PSAPs") to resolve this issue. Accordingly, the wireless industry proposes the following workplan with scheduled milestones for developing and providing technical solutions for TTY users to access digital wireless systems.

PROPOSED WORKPLAN

I. **Assessment of Test Results and Development of Test Plan**

To date, the TTY Forum has focused on "backward" compatibility, *i.e.*, solving for 45.45 baud Baudot signaling. The TTY Forum provided preliminary test results and demonstrations on several potential methods for addressing "backward" compatibility between TTYs and the different wireless digital technologies. The TTY Forum has developed a uniform test script that manufacturers representing various digital technologies and at least one TTY manufacturer have used in their testing. Test results, however, indicate a wide variance in the character error rate. Furthermore, trying to isolate the cause of the problem within a short time frame has been a Herculean yet circumspect task with no conclusive results to date. While the goal is to minimize the character error rate, particularly in 9-1-1 situations, a certain character error rate is inherent with wireline and wireless, both analog and digital technology, and TTY devices. Moreover, there is concern that the wide variance in test results may be contributed by inconsistent test methods, inconsistent methods of evaluating test results among the various manufacturers, and inconsistent performance of various TTY equipment .

The wireless industry recognizes the need for the development of a consistent test method, a uniform method of evaluating the test results ("test plan"), and TTY performance standards to determine the minimal level of character error rate that TTY users can expect with certain digital technologies and certain TTY devices. To address this issue, the wireless industry proposes to do the following activities:

A. **Independent review and assessment of tests conducted to date.**

The TTY Forum has requested Dr. Dale Hatfield, Chief of the FCC's Office of Engineering and Technology ("OET") to review and assess the tests conducted to date. It is anticipated that Mr. Hatfield will provide guidance to the TTY Forum on the soundness of the research conducted to date and identify any discontinuity or gaps in such research that should be explored in the development of a consistent test plan, as defined below.

Primary Responsibility: Dale Hatfield/FCC OET
Completion Date: TBD

B. Development of test plan

In conjunction with the TTY Forum, the wireless digital technology groups[1] (CDG, GSM North America and UWC Consortium) shall develop a consistent test method[2] and method of evaluating test results ("test plan") for its respective digital technology (CDMA, TDMA, GSM 1900). The wireless digital technology groups shall seek input from technical experts that represent TTY manufacturers, PSAPs and consumer groups, *i.e.*, Gallaudet University. The wireless digital technology groups should also consider any guidance from Dr. Hatfield with respect to any discontinuity or gaps in research that should be explored in the development of a consistent test plan. Each wireless digital technology group will be responsible for distributing the test plans to their respective members.

TTY manufacturers, PSAPs and Gallaudet University shall make available their technical experts and any technical data necessary for the development of the test plan.

Primary Responsibility: TTY Forum, CDG, GSM North America, UWC Consortium; TTY manufacturers, PSAPs, and Gallaudet University
Completion date: mid-late September 1998

C. Conduct tests using test plan and compare new results

Member companies will conduct tests and submit results to their respective wireless digital technology groups for compilation, comparison, and any necessary modifications.

TTY manufacturers, PSAPs and Gallaudet University shall make available their technical experts, technical data and assistance necessary for manufacturers to conduct the appropriate tests.

Primary Responsibility: Individual manufacturers and carriers, TTY manufacturers, PSAPs, and Gallaudet University
Completion date: 30-45 days after receipt of uniform test plan

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[1] For purposes of the Workplan, wireless digital technology groups means the CDMA Development Group ("CDG"), GSM North America, and Universal Wireless Communications Consortium ("UWC Consortium").

[2] It is anticipated that the test plan will include the uniform test script developed by the TTY Forum.

D. **Presentation of test results derived from use of test plan**
The respective wireless digital technology groups will present the test results derived from the use of the test plan to the TTY Forum. Based on these tests results, the TTY Forum will reassess whether to continue pursuing "backward" compatibility, redirect research and development efforts toward providing data solutions or a combination.

Primary Responsibility: CDG, UWC Consortium, GSM North America, TTY Forum
Completion date: Subsequent TTY Forum Meeting

III. Development of Technical Requirements and Implementation Guidelines

The wireless industry acknowledges that the development of technical requirements and implementation guidelines cannot be accomplished in a technical vacuum. Compatibility means the ability of two products -- the digital wireless handset and the TTY device -- to co-exist in a digital environment. The wireless industry, PSAPS, TTY manufacturers and Gallaudet University must work cooperatively to provide technical requirements that will facilitate such compatibility, particularly for standard and modified voice-based solutions.[3]

A. **Development of technical requirements - digital wireless handsets**
Based on the test results derived from the test plan, each wireless digital technology group will provide the appropriate technical performance criteria and specifications that will allow TTY users to access 9-1-1 over digital wireless systems in accordance with the solution(s) selected by the respective wireless digital technology groups.

While 9-1-1 access is the immediate goal, each wireless digital technology group will also provide the appropriate technical performance criteria and specifications that will allow TTY users to access digital wireless systems for non-emergency calls in accordance with the solution(s) selected by the respective wireless digital technology groups.

Notwithstanding the foregoing provision, manufacturers and carriers that pursue data solutions based on proprietary technical

[3] It appears that data solutions may not require TTY users to depend solely upon existing TTY devices.

data are not obligated to share such technical performance criteria and specifications if the information is deemed confidential. Nothing in this provision shall prohibit or restrain wireless carriers and manufacturers from pursuing a proprietary technical solution that will provide innovative digital wireless technology to TTY users.

Primary Responsibility: Wireless digital technologies groups
Completion Date: TBD in implementation guidelines

B. **Development of technical requirements - TTY devices**
To facilitate compatibility as defined in the previous paragraph, the wireless digital technology groups are dependent upon TTY manufacturers willingness and commitment to develop performance standards for their respective TTY devices. Based on these requirements, the TTY manufacturers will develop a TID as an interim document to provide technical guidance to the respective digital wireless technology groups.

With the support of the TTY Forum, the TTY manufacturers will initiate a parallel effort with the appropriate standards setting body and will develop the appropriate SRD for TTY performance standards for submission at the next subsequent meeting of the relevant standard committee.
Primary Responsibility: TTY manufacturers, TTY Forum
Completion Date: [Seek input from TTY manufacturers re: reasonable dates]

C. **Development of technical requirements - PSAPs' equipment**
[Seek input from PSAPs]

D. **Development of user requirements**
At TTY Forum 6, the consumer advocacy groups offered a document that provides consumer approved criteria for acceptance of the proposal concerning "one phone model per service provider as of October 1, 1998." The purpose of the document is to stimulate discussion and solicit the view of the manufacturers and carriers. While it appears that the proposal is moot with respect to the October 1, 1998 compliance date, some of the listed criteria provides useful guidance to manufacturers and carriers in their efforts to provide technically feasible solutions for TTY users to access 9-1-1 over digital wireless systems.

The wireless industry acknowledges the consumers' request that essential features of a technical solution include: a) built-in vibrating ring signal or remote vibrator. (If hands-free adapter is used, the phone model should still vibrate.); b) volume control; c)

IV. Development and Deployment

Individual manufacturers and carriers will develop the appropriate prototypes for the solutions that best supports their respective digital wireless technology and produces the minimum TTY character error rate. Individual manufacturers and carriers will conduct the appropriate field tests, *e.g.,* TTY Forum Benchmark/Validation Test. The results of these field tests will be compared and compiled by each wireless digital technology group for their respective digital technologies and will be submitted at the next subsequent TTY Forum Meeting. If necessary, manufacturers and carriers will make modifications based on shared test results. Manufacturers will complete implementation in the mobile handsets which includes product design, development and fabrication, and provide carriers with a commercial product(s).

Primary Responsibility: individual manufacturers and carriers; Field Tests – individual manufacturers and carriers, Gallaudet University (proposed); Wireless digital technologies groups
Completion Date: TBD in implementation guidelines

V. Technical Solutions

Test results derived from the use of the test plan may indicate that not all digital wireless technologies or all TTY devices can achieve compatibility with each technical solution listed below. To provide TTY users with a variety of solutions and to allow manufacturers and service providers maximum flexibility to develop innovative technology and services for TTY users, the wireless industry will provide a range of solutions[5] that will allow TTY users to access digital wireless systems. *While the wireless industry will attempt to minimize the character error rate, it cannot guarantee, at this time, a specific character error rate for any solution.*

A. Standard voice-based solutions[6]

The short-term goal is to provide TTY users *with access to 9-1-1* over digital wireless systems without defaulting to analog. Under standard voice-based solutions, each carrier will provide one compatible digital phone model, to be tested and used with a

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[5] Based on the test results from the digital wireless technology groups, each group should have the freedom to create solutions unique to their respective technologies. Thus, there should be a variety of unique solutions rather than limiting TTY users to three digital "flavors" for each solution.

[6] Examples of the standardized voice-based solution include, but are not limited to, the acoustic coupling method proposed by Ericsson at previous TTY Forums, and the Lober & Walsh adapted TTY and proposed interface presented at TTY Forum 5 and 6.

compatible TTY model, at a reasonable price, for each digital technology that the carrier offers. It appears that standard voice-based solutions can be achieved in the time frame listed below, *provided that* there are: 1) no major changes to the vocoder, 2) no new features added to the handset, 3) only one digital phone model per each digital technology, 4) cooperation from the TTY manufacturers to provide a range of audio input levels in TTY devices acceptable to certain digital wireless handsets, and 5) as noted above, no guarantees with respect to a specific character error rate.

While the standard voice-based solutions attempt to achieve "backward" compatibility with Baudot TTYs, this solution is dependent upon the TTY Forum's reassessment of research and development discussed in Paragraph 1.D.

Primary Responsibility: Individual manufacturers and carriers
Completion date: To Be Discussed[7]
Commercial Availability of Product: To Be Discussed[7]

B. Modified voice-based solutions.
For those wireless companies that plan to pursue an alternate or modified voice-based solutions via direct electrical connection, *e.g.,* RJ-11 connector, a 2.5 mm jack, etc., the TTY Forum is in the process of drafting and will make available a Technical Information Document ("TID").[8] In order to make this solution available in a timely manner, the wireless companies will need the cooperation of the TTY manufacturers to provide a range of audio input levels acceptable to digital wireless handsets.

With the support of CTIA and PCIA, the TTY Forum will initiate a parallel effort with the appropriate standards setting body and will develop a Standards Request Document ("SRD") for submission at

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[7] "Completion date" and "commercial availability of product" are contingent upon several factors, *e.g.,* the timely completion of the work outlined in Sections II, III and IV, additional research that may be necessary, commitment of the Stakeholders to participate in the proposed workplan, and unforeseen delays as a result of technical reasons. Target dates that allow flexibility due to the above factors will be discussed at the forthcoming meeting of the CTIA Ad Hoc Working Group.

[8] The Technical Information Documents referred to in this workplan will be used for information purposes to provide technical guidance to manufacturers and carriers until the development of a standard. The TID is not an endorsement of any particular solution or requirement and shall be used on a voluntary basis.

the next subsequent meetings of the standards committees of the respective digital wireless technologies. All Stakeholders of the TTY Forum will be expected to support efforts in the appropriate standards setting body.

Primary Responsibility: Individual manufacturers and carriers that plan to pursue modified voice-based solution via direct electrical connection; TTY Forum – TID; CTIA, PCIA and TTY Forum – SRD and shepherding through standards process
Completion Date: To Be Discussed[7]
Commercial Availability of Product: To Be Discussed[7]

C. **Data solutions**

Some wireless companies plan to pursue data solutions, *e.g.*, use of the V.18 standard, circuit switched data or proprietary, interactive data and text-messaging services. With the assistance of the wireless digital technologies groups, the TTY Forum will provide a TID for the V.18 standard and circuit switched data for those carriers and manufacturers that wish to pursue such data solutions. Some manufacturers and carriers plan to pursue data solutions for TTY users based on proprietary technical data.[9]

With the support of CTIA and PCIA, the TTY Forum will initiate a parallel effort with the appropriate standards setting body and will develop the appropriate SRDs for data solutions for submission at the next subsequent meetings of the respective standards committees of the various digital wireless technologies. Those manufacturers and carriers that plan to offer data solutions based on proprietary technical data are not expected to submit their proprietary information to the standards-setting process. All Stakeholders of the TTY Forum will be expected to support efforts in the appropriate standards setting body.

Primary Responsibility: Wireless digital technologies groups, CTIA, PCIA, individual manufacturers and carriers
Completion Date: To Be Discussed[7]
Commercial Availability of Product: To Be Discussed[7]

VI. **Notification to Subscribers and Potential Subscribers who use TTYs**

In compliance with the FCC's rules, wireless carriers have notified subscribers and potential subscribers that they may not be able to use

[9] The goal is to provide TTY users with a variety of data and text-messaging solutions. Rather than lock digital wireless technologies into one or two data solutions, the Workplan attempts to provide carriers and manufacturers with the flexibility to provide their TTY customers with a variety of solutions.

TTYs to access 9-1-1 over digital wireless systems. Wireless carriers, with the support of the wireless trade associations, the consumer advocacy groups, TTY manufacturers and wireless handset manufacturers, will continue to notify subscribers and potential subscribers at appropriate intervals until a product is commercially available.

Primary Responsibility: individual wireless carriers and manufacturers, TTY manufacturers, consumer advocacy groups, CTIA and PCIA
Completion Date: On-going

VII. Consumer Education

[TBD after the parties have the opportunity to assess their resources with respect to a concerted effort to educate TTY users regarding the use of wireless telecommunications, particularly transitioning the embedded base of Baudot TTY users to data solutions.]

September 28. 1998

Wireless Industry TTY Forum
CTIA
1250 Connecticut Ave N.W.
Suite 200
Washington. DC 20036

Dan Phythyon
Chief
Wireless Telecommunications Bureau
FCC
2025 Mst N.W.
Room 500
Washington, DC 20554

Dear Mr. Phythyon

On behalf of the members of the Wireless Industry's TTY Forum an extension of three (3) months to the TTY compliance date is hereby requested. The three month extension would push-back the TTY compliance date as specified in 47 C.F.R. Section 20.18(c) from October 1, 1998 to January 1, 1999.

As you know the TTY Forum was established as a result of the FCC requirement to support TTY signaling over digital air interfaces. The Forum held its first meeting during September 1997 and has conducted a total of seven (7) meetings since then. The members of the Forum include all "stakeholders". Formally represented at all TTY Forum activities are representatives of the deaf and heard of hearing, TTY manufacturers. public safety, wireless phone manufacturers and wireless service providers. Our accomplishments are reflected in the quarterly TTY Reports submitted by CTIA on behalf of the Forum.

The intent of the Forum is to provide the FCC with consensus opinions, comments and recommendations. based on technical findings. as to how best to achieve the goal. The Forum has been fastidious in its work. scope and charter. Work completed to date has demonstrated effective diagnosis and problem solving techniques. The technical tests have broken new ground, discoveries have been significant and *Agreement Statements* on critical issues have been reached. My conversations with you and your staff have emphasized that this issue is and remains extremely technically challenging. Regardless, the Forum continues as a cohesive body, ready and willing to face those challenges.

We all agree that it is unfortunate that this effort is behind schedule. None the less. we remain committed to our goal. As of this date however. it is the consensus of the Forum that an additional three months will allow the completion of various lab/field testing, the